New Device Monitors Metal Content in Stack Emissions at Tooele

By Dana Finney

A multi-metal continuous emission monitor tested at Tooele Army Depot, UT, could greatly lessen the burden and cost of complying with the 1990 Clean Air Act Amendments (CAAA). Developed by the Engineer Research and Development Center (ERDC) in partnership with Cooper Environmental Services, Beaverton, Ore., the device uses X-ray fluorescence to simultaneously check for up to 19 different hazardous metals as emissions exit the stack.

The new device is called XCEM, for X-Ray Fluorescence-Based Multi-Metal Continuous Emission Monitor. ERDC's Construction Engineering Research Laboratory (CERL) installed the prototype during FY02 on Tooele's conventional munitions furnace, which is the only one currently operating in the U.S.

"All demilitarization incinerators, both conventional and chemical, emit metals as byproducts of combustion," said Dr. James Hay, CERL project manager for the technology. "It's a difficult process to determine the metal content using traditional methods. To comply with increasingly stringent emission standards, the Army needed a faster, more accurate way to monitor emissions."

According to Dee Russell in Tooele's Ammunition Operations Directorate, current sampling procedures are not only cumbersome, but also expensive. "We have to spend $600,000 every two years to do trial burns, which take two months to complete. Then all it tells you is what came out of the stack, which depends on what you put into the furnace and the different parameters used, such as temperature and feed rate," he said, adding that if any facet of production changes, new burn tests must be conducted.

The X-ray fluorescence component of XCEM is the analytical tool while an automated sampling system provides extractive batch sampling onto a resin-impregnated filter tape. When the tape is spent, it can be removed and analyzed to verify that the monitor was working properly. XCEM samples the emissions every 20 minutes and a computer interface notifies the furnace operator if the level of any contaminant is approaching limits set by the U.S. Environmental Protection Agency (USEPA) National Emissions Standard for Hazardous Air Pollutants (NESHAP). If so, the operator can immediately invoke measures to control it, such as slowing the feed rate.

"XCEM is also advantageous because if there are chemical substances present that the technical data doesn't show, it will catch it," said Russell. "We base our burn tests on drawings provided by the munitions manufacturer, and if there would happen to be an error about any constituent, for whatever reason, this will prevent us from inadvertently releasing something that could take us out of compliance."

The monitor is interfaced with easy-to-use software that provides sensor integration, automation, quality assurance routines, automatic calibration, and report generation. According to Hay, another benefit of continuous monitoring at the stack is that the combustion process could be optimized.

"Using the data from the monitor, the operators can make adjustments that result in decreased emissions, better efficiency, higher production rate, and possibly eliminate the need for controls," he said.

Russell added, "If what's coming out of the stack is the most important concern, why not use this type of monitoring and control it there. In a multi-million dollar operation, if we could just increase productivity by one percent, we would see a huge savings. It might also allow us to use the scrubbers less often, which would avoid producing hazardous wastewater."

XCEM is commercially available, costing about $200K per unit. According to Russell, this is about one-half the cost of other systems Tooele evaluated, with replacement parts averaging about one-tenth as costly. "We were looking at products that cost half a million dollars to purchase, and the parts were outrageous." Some of the other off-the-shelf monitors also were difficult to operate and interpret results.

In addition to demilitarization furnaces, XCEM could have application at any other industrial plant that emits hazardous metals, such as cement manufacturers or coal-fired boilers. A spin-off technology called XCMM, which continuously monitors mercury levels, was evaluated in an EPA-sponsored test during summer 2003. CERL is seeking a demonstration site to install XCMM during FY04.

For more information about these monitors or any hazardous air pollutant (HAP) issue, please contact Dr. James Hay at CERL, 217-373-3485, email Kent.J.Hay@erdc.usace.army.mil.